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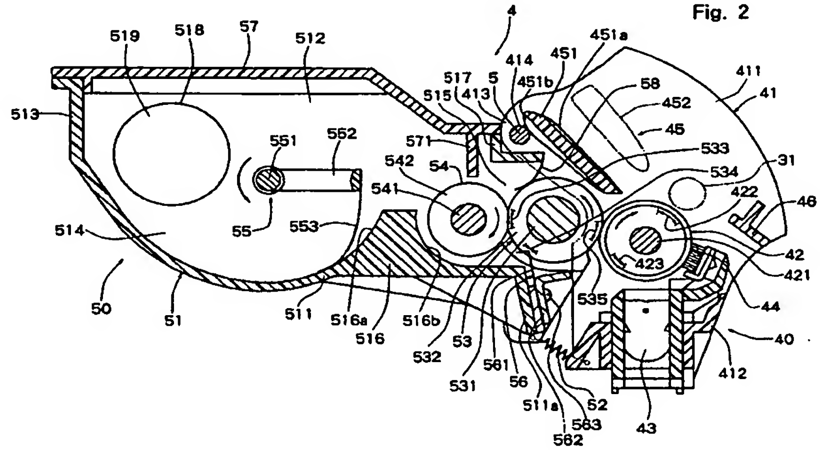
(54) Process unit

(57) A process unit (4) including a photoconductor unit (40) having a photoconductor drum (42), a developing unit (50) having a developing roller (53) disposed in a development housing (51), and a support shaft (5) means for supporting the developing unit (50) pivotably relative to the photoconductor unit (40). The developing roller (53) is disposed such that its surface is pressed against the surface of the photoconductor drum (42) in a developing zone. The photoconductor drum (42) and the developing roller (53) are rotationally driven such that their respective surfaces move from below to above in the developing zone.

Fig. 2



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Description

Field of the Invention

The present invention relates to a process unit which is mounted detachably on an image forming machine such as an electrostatic copier or a laser printer.

Description of the Prior Art

A typical example of a process unit of the above-mentioned type includes a photoconductor unit having a photoconductor drum on whose surface a latent electrostatic image is formed by an exposure means; a developing unit having a development housing accommodating a developer, and a developing roller disposed in the development housing; and a support shaft means supporting the developing unit pivotably relative to the photoconductor unit. The developing roller is disposed such that its surface is pressed against the surface of the photoconductor drum in a developing zone, thereby to supply in the developing zone a developer to a latent electrostatic image formed on the surface of the photoconductor drum. A nonmagnetic one-component developer is used as the developer.

In the above type of process unit, assume that the position of transfer is defined above the photoconductor drum, namely, that a sheet of transfer paper (a so-called transfer sheet) moves above the photoconductor drum in the direction of a tangent to the photoconductor drum. In this case, the photoconductor drum is rotationally driven such that its surface moves from below to above in the developing zone. Whereas the developing roller is rotationally driven such that its surface moves in a direction opposite to the moving direction of the photoconductor drum, namely, from above to below in the developing zone. A developer regulating means for regulating the amount of the developer held on the peripheral surface of the developing roller is disposed above the developing roller.

In putting the aforementioned type of process unit to practical use, however, it is necessary to solve the following technical problems:

First, a fully satisfactory image free from a fog should be obtained stably. In the above-described conventional process unit, the developing roller is generally composed of an elastic material, i.e., a synthetic rubber material such as urethane rubber. Thus, the surface of the developing roller is shaved at its upper part by the developer regulating means pressed against this surface. Its shavings are conveyed to the developing zone, accumulated above the developing zone, and partly sent into the developing zone. As a result, black dots may occur in the image, or the photosensitive layer of the photoconductor drum may be damaged to cause streaks in the image. When the developer regulating means is composed of a rubber blade, the rubber blade is shaven, and its shavings are conveyed to the developing zone, and accumulated above the developing zone. This may cause similar drawbacks. Owing to the buildup of the developer above the developing zone, moreover, a fog occurs. The occurrence of the above-described drawbacks, therefore, results in the failure to obtain a fog-free, fully satisfactory image stably. If the photoconductor drum is damaged, furthermore, the interval to the next replacement of the process unit is shortened, and thus, cannot be maintained as scheduled.

Secondly, the manufacturing cost should be reduced, and the product should be sufficiently compact in size. With the conventional process unit, the developing roller is rotationally driven such that its surface moves in a direction opposite to the moving direction of the photoconductor drum, namely, from above to below in the developing zone. Thus, the drive torque of the developing roller increases. Consequently, a rotational drive source generally composed of an electric motor becomes large in size. This increases the manufacturing cost, and cannot make the entire process unit sufficiently compact.

Summary of the Invention

The present invention has been accomplished in the light of the foregoing facts. Its principal object is to provide a novel process unit which can give a fog-free, fully satisfactory image stably, and can be reduced in the manufacturing cost, and can be made sufficiently compact in size.

The present invention provides a process unit detachably mounted on an image forming machine, the process unit including a photoconductor unit having a photoconductor drum on whose surface a latent electrostatic image is formed; a developing unit having a development housing accommodating a developer, and a developing roller disposed in the development housing; and a support shaft means for supporting the developing unit pivotably relative to the photoconductor unit; the developing roller being disposed such that its surface is pressed against the surface of the photoconductor drum in a developing zone, thereby to supply in the developing zone a developer to a latent electrostatic image formed on the surface of the photoconductor drum; wherein

> the photoconductor drum and the developing roller are rotationally driven such that their respective surfaces move from below to above in the developing zone.

In the present invention, the photoconductor drum and the developing roller are rotationally driven such that their respective surfaces move from below to above in the developing zone. That is, the developing roller is rotationally driven such that its surface moves from below to above in the developing zone. Thus, shavings

of the developing roller, formed by the developer regulating means, or shavings of the developer regulating means per se, are not accumulated above the developing zone. Hence, the penetration of these shavings into the developing zone is reliably prevented. As a result, a fog-free, fully satisfactory image can be obtained stably. Moreover, damage to the photoconductor drum is surely avoided. Thus, the interval to the next replacement of the process unit is not shortened, but can be maintained as scheduled.

In addition, the photoconductor drum and the developing roller are adapted to be rotationally driven such that their respective surfaces move from below to above, i.e., in a forward direction, in the developing zone. Thus, the drive torque of the developing roller decreases. Consequently, a rotational drive source generally composed of an electric motor can be made small in size. This decreases the manufacturing cost, and can make the entire process unit sufficiently compact.

In addition to the foregoing constitution, the present invention provides a process unit further including a spring means; wherein

> the spring means is interposed between the developing unit and the photoconductor unit to impart a turning moment about the support shaft means to the developing unit so that the developing roller is urged toward the photoconductor drum,
> the peripheral speed of the developing roller is set to be higher than the peripheral speed of the photoconductor drum, and
> when viewed in the direction of the axis of the developing roller, the support shaft means is disposed in a region located on the side opposite to the photoconductor drum with respect to a straight line which is parallel to a tangent passing through the nip between the developing roller and the photoconductor drum, and which passes through the shaft center of the developing roller, the region being above a straight line passing through the shaft centers of the developing roller and the photoconductor drum.

In this invention, the peripheral speed of the developing roller is set to be higher than the peripheral speed of the photoconductor drum. Thus, the supply of the developer from the developing roller to the photoconductor drum is performed sufficiently stably to obtain a fully satisfactory image. Because of the above difference in speed, however, a counterforce parallel to the tangent to the nip between the developing roller and the photoconductor drum is caused to the shaft center of the developing roller. The support shaft means is disposed in the aforementioned region. This arrangement at least prevents part of the counterforce (a component of force) from acting in a direction in which it presses the developing roller against the photoconductor drum. Hence, the spring means interposed between the developing unit and the photoconductor drum can be utilized to initially set the force of pressed contact between the photoconductor drum and the developing roller easily and reliably. If this initial setting of the force of pressed contact is easy, it will become easy to set this force of pressed contact as desired. Hence, the supply of the developer by the developing roller is performed always stably, so that a fully satisfactory image can be obtained stably.

Brief Description of the Drawings

> Fig. 1 is a front view schematically showing a printer on which an embodiment of a process unit constructed in accordance with the present invention is mounted;
> Fig. 2 is a sectional view of the process unit of Fig. 1; and
> Fig. 3 is a view for illustrating the position of a support shaft in the process unit of Fig. 2.

Detailed Description of the Preferred Embodiments

An embodiment of a process unit of an image forming machine constructed in accordance with the present invention will be described in detail with reference to the accompanying drawings. In the illustrated embodiment, a printer will be taken as an example of the image forming machine equipped with the process unit constructed in accordance with the invention.

Fig. 1 schematically shows a printer 2 on which an embodiment of the process unit constructed in accordance with the invention is mounted. In this embodiment, the printer 2 is a compact, slow-speed laser printer for use as a printer for a word processor, and has a machine housing 20 molded from a plastic material. This machine housing 20 includes an upwardly open box-shaped housing body 21, and a cover 23 mounted turnably on a shaft 22 disposed at the top of the housing body 21. At nearly the center of the machine housing 20 so constructed, a process unit 4 is mounted detachably.

The process unit 4, as shown in Fig. 2, has a photoconductor unit 40, and a developing unit 50, as a latent electrostatic developing device, which is supported pivotably relative to the photoconductor unit 40 via a support shaft 5 constituting a support shaft means. The photoconductor unit 40 has a photoconductor support means 41. The photoconductor support means 41 has a pair of side wall members 411 arranged with spacing in the back-and-forth direction (the direction perpendicular to the sheet face of Fig. 2) (only the rear side wall member is shown in Fig. 2), and a connecting member 412 which connects together lower parts of the pair of side wall members 411. The so constructed photoconductor support means 41 is integrally molded from a plastic material. At the upper end parts, on the developing unit 50 side, of the pair of side wall members 411 constituting the photoconductor support means 41, support portions 413 having mounting holes 414 are provided. By inserting the support shaft 5 made of a metal

bar material, which is disposed in a development housing (to be described later on) of the developing unit 50, into the mounting holes 414 provided in the support portions 413, the photoconductor unit 40 and the developing unit 50 are supported so as to be pivotable relative to each other.

The photoconductor unit 40 has a photoconductor drum 42 having a photosensitive layer on its peripheral surface. The photoconductor drum 42 has its rotating shaft 421 rotatably supported by the pair of side wall members 411 constituting the photoconductor support means 41, and rotationally driven by a drive means (not shown) in the direction of an arrow, i.e., such that its surface will move from below to above in a developing zone, the site of contact (the site of nip) with a developing roller (to be described later on) of the developing unit 50. On the connecting member 412 of the photoconductor support means 41, a charging corona discharger 43 is disposed opposite the lower peripheral surface of the photoconductor drum 42. Upstream from the charging corona discharger 43 in the direction of rotation of the photoconductor drum 42, a paper dust removing brush 44 is disposed in contact with the peripheral surface of the photoconductor drum 42.

Between the pair of side wall members 411 constituting the photoconductor support means 41, there is disposed a lower guide plate 451 constituting one of a pair of pre-transfer guide plates 45 for guiding a transfer sheet, which is fed from upper left in Fig. 2, toward a transfer zone 422 on the peripheral surface of the photoconductor drum 42. This lower guide plate 451 is molded integrally with the pair of side wall members 411. On the top surface of the lower guide plate 451, a plurality of guide ribs 451a are integrally molded with spacing in the longitudinal direction (the direction perpendicular to the sheet face of Fig. 2). On the bottom surface of the lower guide plate 451, too, a plurality of reinforcing ribs 451b are integrally molded with spacing in the longitudinal direction. These reinforcing ribs 451b are adapted to contact the support shaft 5. Thus, the lower guide plate 451 can be prevented from deflecting because of the contact of the reinforcing ribs 451b with the support shaft 5, even when a pressing force acts on the top surface of the lower guide plate 451 in an attempt to cause its deflection. The lower guide plate 451 can also function as a connecting member for connecting together the upper parts of the pair of side wall members 411 constituting the photoconductor support means 41, thereby improving the rigidity and strength of the photoconductor support means 41. In the illustrated embodiment, moreover, the lower guide plate 451 is molded integrally with the pair of side wall members 411, so that it can maintain a highly precise positional relationship with the photoconductor drum 42 supported rotatably on the pair of side wall members 411.

Between the pair of side wall members 411 constituting the photoconductor support means 41, a post-transfer guide plate 46 is disposed for guiding the transfer sheet, undergoing transfer in a transfer zone 422, to a fixing means to be described later on. The post-transfer guide plate 46 is molded integrally with the pair of side wall members 411. Thus, the post-transfer guide plate 46 can function as a connecting member for connecting together the pair of side wall members 411 constituting the photoconductor support means 41, thereby improving the rigidity and strength of the photoconductor support means 41.

Next, the developing unit 50 as a latent electrostatic image developing device will be described. The developing unit 50 in the illustrated embodiment has a development housing 51 accommodating a developer comprising a one-component toner. The development housing 51 is composed of a bottom wall 511, a front side wall 512 and a rear side wall 512 (only the rear side wall is shown in Fig. 2) erected upright from the front and rear ends of the bottom wall 511 (the ends in the direction perpendicular to the sheet face of Fig. 2), and a left side wall 513. These walls are integrally molded from a plastic material, defining an agitation chamber 514 and a development chamber 515. On the bottom wall 511 constituting the development housing 51, a partition wall 516 provided in the back-and-forth direction (the direction perpendicular to the sheet face in Fig. 2) is integrally molded between the agitation chamber 514 and the development chamber 515. The left and right surfaces of the partition wall 516 are formed as arcuate guide surfaces 516a and 516b. Between the front and rear side walls 512 constituting the development housing 51, a connecting member 517 disposed in an upper part on the development chamber 515 side is provided integrally with the front and rear side walls 512. In the rear side wall 512 constituting the development housing 51, a toner supply hole 518 is formed. The toner supply hole 518 is fitted with a cap 519.

In an upper end part, on the development chamber 515 side, of the so constructed development housing 51, the support shaft 5 is disposed so as to pass through the front and rear side walls 512. By fitting both end parts of the support shaft 5 into the mounting holes 414 provided in the support portions 413 of the pair of side wall members 411 constituting the photoconductor support means 41 of the photoconductor unit 40, the photoconductor unit 40 and the developing unit 50 are supported so as to be pivotable relative to each other. Between a front end site of a lower end part of the photoconductor support means 41 of the photoconductor unit 40 and a rear end site of a lower end part of the development housing 51, coiled springs 52 are interposed as spring means. These coiled springs 52 urge the photoconductor unit 40 and the developing unit 50 toward each other about the support shaft 5. The development housing 51 is open upwards and rightwards, i.e., on the photoconductor unit 40 side.

Inside the development housing 51, a developing roller 53, a makeup roller 54, an agitating means 55 and a developer regulating means 56 are disposed. The developing roller 53 is disposed in the development chamber 515 of the development housing 51, and

includes a rotating shaft 531 mounted rotatably on the front and rear side walls 512 constituting the development housing 51, and a solid synthetic rubber roller 532 secured to the outer peripheral surface of the rotating shaft 531. The rotating shaft 531 may be formed of a suitable metallic material such as stainless steel. The solid synthetic rubber roller 532 is composed of a relatively flexible and conductive material, e.g., conductive solid synthetic rubber such as urethane rubber. In the illustrated embodiment, the surface roughness of the peripheral surface of the solid synthetic rubber roller 532, i.e., the 10-point average roughness Rz defined in JIS B 0601, is set at 5.0 to 12.0. The volume resistivity of the solid synthetic rubber roller 532 is set at about 10^4 to 10^9 $\Omega \cdot$cm. The roller hardness of the solid synthetic rubber roller 532 is set at an Asker hardness of 60 to 80 in the illustrated embodiment.

The so constructed roller 532 of the developing roller 53 is exposed through the right-hand opening formed in the development housing 51, and positioned opposite the photoconductor drum 42. The peripheral surface of the roller 532 constituting the developing roller 53 is pressed against the peripheral surface of the photoconductor drum 42 in the developing zone. At the nip in this pressed condition, the peripheral surface of the roller 532 is compressed slightly elastically. The rotating shaft 531 of the developing roller 53 is rotationally driven by a drive means (not shown) in the direction of an arrow. That is, the developing roller 53 is rotationally driven so that its surface moves from below to above in the developing zone, the site of contact between the roller 532 and the photoconductor drum 42. In accordance with this rotation, the peripheral surface of the roller 532 is sequentially moved through a developer holding zone 533, a developer regulating zone 534, and a developing zone 535. In the illustrated embodiment, a constant voltage of 300V is applied to the rotating shaft 531 of the developing roller 53.

The makeup roller 54 is disposed parallel to the developing roller 53 inside the development chamber 515 of the development housing 51. The makeup roller 54 includes a rotating shaft 541 mounted rotatably on the front and rear side walls 512, and a roller 542 secured to the outer peripheral surface of the rotating shaft 541. The rotating shaft 541, like the rotating shaft 531 of the developing roller 53, may be formed of a suitable metallic material, such as stainless steel. The roller 542 is composed of a foam such as silicone foam or urethane foam. The roller 542 is pressed against the roller 532 of the developing roller 53 in the developer holding zone 533, the nip between the roller 542 and the developing roller 53. The hardness of the foam constituting the roller 542 of the makeup roller 54 is much smaller than the hardness of the roller 532 constituting the developing roller 53 (for example, an Asker hardness of about 35), and it is desirable that by being pressed against the roller 532 of the developing roller 53, the roller 542 be elastically compressed in the nip region by about 0.1 to 0.6 mm. The roller 542 also has conductivity, and its volume resistivity is set at about 10^2 to 10^6 $\Omega \cdot$cm. The rotating shaft 541 of the developing roller 54 is rotationally driven by a drive means (not shown) in the direction of an arrow, i.e., so that the roller surface moves from above to below in the developer holding zone 533, the nip between the roller 542 and the roller 532 of the developing roller 53. In accordance with this rotation of the rotating shaft 541, the roller 542 is also rotationally driven in the direction of the arrow. In the illustrated embodiment, a constant voltage of 450V, a higher voltage than the voltage applied to the developing roller 53, is applied to the rotating shaft 541 of the makeup roller 54.

The peripheral speed V1 of the photoconductor drum 42, the peripheral speed V2 of the developing roller 53, and the peripheral speed V3 of the makeup roller 54 are set in the relationship $V1<V2<V3$. In the illustrated embodiment, the relation between the peripheral speed V1 of the photoconductor drum 42 and the peripheral speed V2 of the developing roller 53 is set to be $1.2V1 \leqq V2 \leqq 2.5V1$, while the relation between the peripheral speed V2 of the developing roller 53 and the peripheral speed V3 of the makeup roller 54 is set to be $1.0V2 \leqq V3 \leqq 2.0V2$. If the peripheral speed V2 of the developing roller 53 is less than 1.2V1, the supply of a developer to the photoconductor drum 42 will be insufficient, and the density of an image may lower. If the peripheral speed V2 of the developing roller 53 is less than 1.2V1, moreover, there will be a decline in the scraping action of the developing roller 53 on the non-transferred developer that adheres to the photoconductor drum 42 after transfer. Thus, the non-transferred developer cannot be removed from the photoconductor drum 42, potentially causing a so-called offset fog. If the peripheral speed V2 of the developing roller 53 is more than 2.5V1, on the other hand, the drive torque of the developing roller 53 will increase, possibly causing a scatter of the developer by a centrifugal force.

If the peripheral speed V3 of the makeup roller 54 is less than 1.0V2, moreover, there will be a weak scraping action of the makeup roller 54 on the peripheral surface of the developing roller 53. In case the non-transferred developer adhering to the photoconductor drum 42 after transfer adheres to the developing roller 53, therefore, this adherent developer will be difficult to remove. The adherent developer may generate a ghost in a subsequent development. If the peripheral speed V3 of the makeup roller 54 is more than 2.0V2, on the other hand, the drive torque of the makeup roller 54 will increase. Simultaneously, the developer will strongly tend to rest above the nip between the makeup roller 54 and the developing roller 53, possibly causing an insufficient supply of the developer to the developing roller 53.

In the agitation chamber 514 of the development housing 51, an agitating means 55 is disposed. The agitating means 55 is disposed parallel to the makeup roller 54, and includes a rotating shaft 551 mounted rotatably on the front and rear side walls 512 constitut-

ing the development housing 51, an agitating member 552 fixed to the rotating shaft 551, and an elastic agitating sheet member 553 mounted to the agitating member 552. The agitating member 552 is formed of a plastic material, and has a plurality of openings in the longitudinal direction (the direction perpendicular to the sheet face of Fig. 2). The agitating sheet member 553 is formed of a flexible, elastic material, such as polyethylene terephthalate (PETP), and is secured by an adhesive or the like to the front edge of the agitating member 552. The so constructed agitating means 55 is rotationally driven continuously by a drive means (not shown) in the direction of an arrow in Fig. 2.

The developer regulating means 56 has a flexible, elastic blade 561 to be pressed against the peripheral surface of the roller 532 constituting the developing roller 53. The blade 561 is composed of, say, a stainless steel plate or a spring steel plate about 0.1 to 0.2 mm thick, and has nearly the same longitudinal dimension as the length of the roller 532 constituting the developing roller 53. The blade 561 has a base end part mounted on a blade mounting portion 511a provided at the open end, on the photoconductor unit 40 side, of the bottom wall 511 constituting the development housing 51. That is, the base end part of the blade 561 is sandwiched between the blade mounting portion 511a and a press plate 562, and is fixed thereto by means of a machine screw 563. A front end part of the blade 561 is bent, and this bend is pressed against the peripheral surface of the roller 532 constituting the developing roller 53 in the developer regulating zone 534.

On the development housing 51, a closure 57 covering the open top of the development housing 51 is mounted. The closure 57 is composed of a plastic material, and is secured by an adhesive to the top surfaces of the front and rear side walls 512, the left side wall 513 and the connecting member 517 that constitute the development housing 51. On the inner surface of the closure 57, a regulating portion 571 is integrally molded which extends in the back-and-forth direction (the direction perpendicular to the sheet face of Fig. 2) at a position opposite the makeup roller 54, and which protrudes on the development chamber 515 side. Between the lower end of the regulating portion 571 and the outer peripheral surface of the roller 542 constituting the makeup roller 54, a predetermined spacing is provided. In the illustrated embodiment, the connecting member 517 constituting the development housing 51 is mounted with a sheet-like seal member 58. The sheet-like seal member 58 is composed of a flexible, elastic sheet member of, say, polyethylene terephthalate (PETP), and has nearly the same length as the axial length of the roller 532 constituting the developing roller 53. The sheet-like seal member 58 has one end part secured to the connecting member 517 by a securing means such as an adhesive, and has the other end part curved and elastically contacted with the peripheral surface of the roller 532 constituting the developing roller 53. The so constructed sheet-like seal member 58 prevents a scatter of the developer from the opening, on the photoconductor unit 40 side, of the development housing 51 in cooperation with the blade 561 of the developer regulating means 56.

In the process unit 4, it is important for the photoconductor drum 42 and the developing roller 53 to be rotationally driven such that their respective surfaces move from below to above in the developing zone 535. According to this constitution, shavings of the developing roller 53 formed by the blade 561, or shavings of the blade 561 itself, if its part of contact with the developing roller 53 is composed of an elastic material, such as synthetic rubber, are not accumulated near the developing zone 535. Hence, the penetration of these shavings into the developing zone 535 is reliably prevented. As a result, a fog-free, fully satisfactory image can be obtained stably. Moreover, damage to the photoconductor drum 42 is surely avoided. Thus, the interval to the next replacement of the process unit 4 is not shortened, but can be maintained as scheduled.

In addition, the photoconductor drum 42 and the developing roller 53 are adapted to be rotationally driven such that their respective surfaces move from below to above, i.e., in a forward direction, in the developing zone 535. Thus, the drive torque of the developing roller 53 decreases. Consequently, a rotational drive source generally composed of an electric motor can be made small in size. This decreases the manufacturing cost, and can make the entire process unit 4 sufficiently compact.

Furthermore, as stated previously, the peripheral speed of the developing roller 53 is set to be higher than the peripheral speed of the photoconductor drum 42. The developing unit 50 is supported so as to be pivotable relative to the photoconductor unit 40 via the support shaft 5. The coiled spring 52 is interposed between the developing unit 50 and the photoconductor unit 40. The coiled spring 52 imparts a turning moment about the support shaft 5 to the developing unit 50 so that the developing roller 53 is urged toward the photoconductor drum 42. The photoconductor drum 42, the developing roller 53 and the support shaft 5 are disposed parallel to each other.

With reference to Fig. 3, it is also important in the process unit 4 that when viewed in the direction of the axis of the developing roller 53 (the direction perpendicular to the sheet face of Fig. 3), the support shaft 5 (its shaft center 5a) be disposed in a region located on the side opposite to the photoconductor drum 42 (i.e. the left side in Fig. 3) with respect to a straight line, L2, which is parallel to a tangent, L0, passing through the nip between the developing roller 53 and the photoconductor drum 42, and which passes through the shaft center 53a of the developing roller 53, the region being above a straight line, L1, passing through the shaft center 53a of the developing roller 53 and the shaft center 42a of the photoconductor drum 42. The support shaft 5 may have its shaft center 5a located on the straight line L2 or on the straight line L1.

As stated above, the peripheral speed of the developing roller 53 is set to be higher than the peripheral speed of the photoconductor drum 42. Thus, the supply of the developer from the developing roller 53 to the photoconductor drum 42 is performed sufficiently stably to obtain a fully satisfactory image. Because of the above difference in speed, however, a counterforce, F1, parallel to the tangent L0 to the nip between the developing roller 53 and the photoconductor drum 42 is caused to the shaft center 53a of the developing roller 53. The support shaft 5 is disposed in the aforementioned region. This arrangement at least prevents a component of the counterforce F1 from acting in a direction in which it presses the developing roller 53 against the photoconductor drum 42.

That is, when the support shaft 5 is positioned between the straight line L1 and the straight line L2, as shown in Fig. 3, the counterforce F1 causes components of force, F2 and F3, to act on the shaft center 53a of the developing roller 53. The component of force F3 acts in a direction in which it separates the developing roller 53 from the photoconductor drum 42. Thus, the initial setting of the force of pressed contact between the photoconductor drum 42 and the developing roller 53 can be performed easily and reliably by utilizing the coiled spring 52 interposed between the developing unit 50 and the photoconductor unit 40. It is easy to decrease, by use of the coiled spring 52, the force F3 working in a direction in which it makes the developing unit 50 and the photoconductor unit 40 away from each other. If this initial setting of the force of pressed contact is easy, it will become easy to set this force of pressed contact as desired. Hence, the supply of the developer by the developing roller 53 is performed always stably, so that a fully satisfactory image can be obtained stably. When the support shaft 5 is positioned on the straight line L1 or L2, there will be no component of force from the counterforce F1 which will direct the developing roller 53 toward the photoconductor drum 42, as will be readily seen from Fig. 3. The initial setting of the force of pressed contact between the photoconductor drum 42 and the developing roller 53, therefore, can be easily performed using the coiled spring 52.

When the support shaft 5 is positioned at a lower part of the developing unit 50, as indicated by a two-dot chain line in Fig. 3, the counterforce F1 causes components of force, F4 and F5 indicated by two-dot chain lines, to act on the shaft center 53a of the developing roller 53. The component of force F5 acts in a direction in which it presses the developing roller 53 against the photoconductor drum 42. The developing roller 53 is composed of synthetic rubber. Thus, a pressing force in a direction in which it makes the developing roller 53 bite into the photoconductor drum 42 additionally acts on the nip between the developing roller 53 and the photoconductor drum 42. This is undesirable in initially setting the force of pressed contact. It is difficult to impart a force for decreasing such a pressing force working in a biting direction. Accordingly, it becomes difficult to perform, as desired, the initial setting of the force of pressed contact between the photoconductor drum 42 and the developing roller 53.

The so constructed process unit 4 is mounted detachably on the machine housing 20 of the printer 2, as shown in Fig. 1. That is, the cover 23 constituting the machine housing 20 of the printer 2 is turned about the shaft 22 counterclockwise in Fig. 1, whereby the top of the housing body 21 constituting the machine housing 20 is opened. Then, the process unit 4 is mounted inside the housing body 21 from above. Inside the housing body 21, a positioning means (not shown) capable of placing the photoconductor unit 40 of the process unit 4 at a predetermined position is provided. After the process unit 4 is mounted inside the housing body 21 of the machine housing 20, the cover 22 is turned about the shaft 22 clockwise in Fig. 1 to close the top of the housing body 21.

As shown in Fig. 1, a laser unit 24 is disposed in a lower part of the housing body 21 constituting the machine housing 20 of the printer 2. This laser unit 24 throws laser light, corresponding to print data from, say, a word processor connected to the printer 2, upon the photosensitive layer of the photoconductor drum 42 in an exposure zone 423 of the process unit 4, thereby forming a latent electrostatic image. In the housing body 21 constituting the machine housing 20 of the printer 2, a fixing roller pair 25 is disposed downstream from the post-transfer guide plate 46. Downstream from the fixing roller pair 25, a discharge roller pair 26 is disposed. Furthermore, a copy receiving or discharge tray 27 is disposed downstream from the discharge roller pair 26.

On the cover 23 constituting the machine housing 20 of the printer 2, a feed tray 28 for bearing a transfer sheet is disposed at an upper left part in Fig. 2. Downstream from the feed tray 28, a feed roller 29 is disposed. This feed roller 29 is rotationally driven by a drive means (not shown) in the direction of an arrow in Fig. 2. Opposite the feed roller 29, a friction pad 30 for sheet separation is disposed. In the transfer zone 422, a non-contact transfer roller 31 is disposed opposite the photoconductor drum 42. The transfer roller 31 is formed of a conductive urethane foam, and rotatably supported on the cover 23. The transfer roller 31 has opposite end parts mounted with collars (not shown) which are composed of an insulating material, such as synthetic resin, and each of which has a larger outside diameter than the diameter of the transfer roller 31. These collars are disposed in contact with the peripheral surface of the photoconductor drum 42. Thus, the transfer roller 31 is caused to follow the rotation of the photoconductor drum 42 while slipping. The clearance between the peripheral surface of the transfer roller 31 and the peripheral surface of the photoconductor drum 42 is set at about 0.5 mm. A constant voltage of, say, 10 μA is applied to the so constructed transfer roller 31. On the cover 23, an upper guide plate 452 constituting the other component of the pre-transfer guide plate pair 45 is disposed.

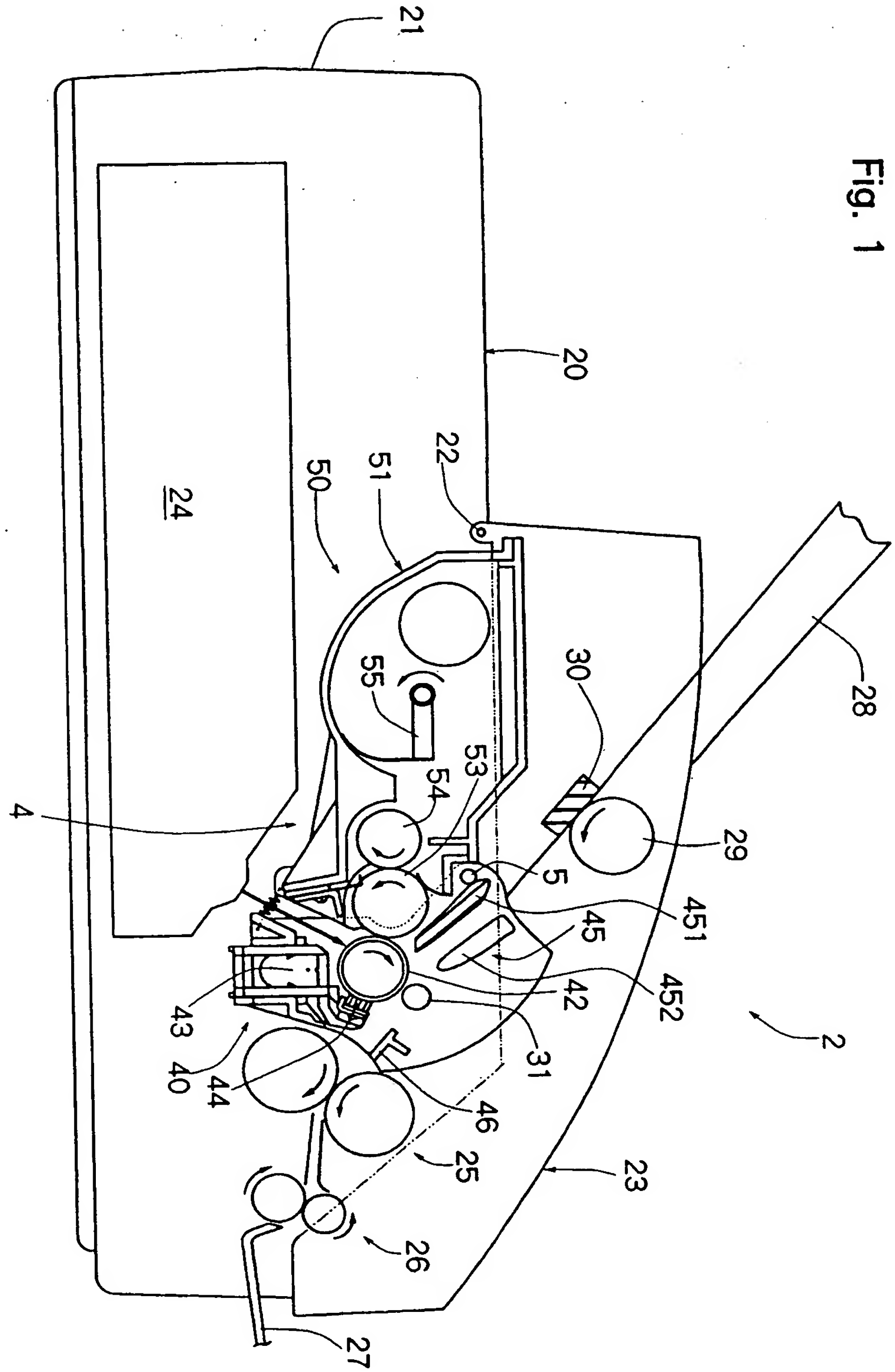
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Fig. 1

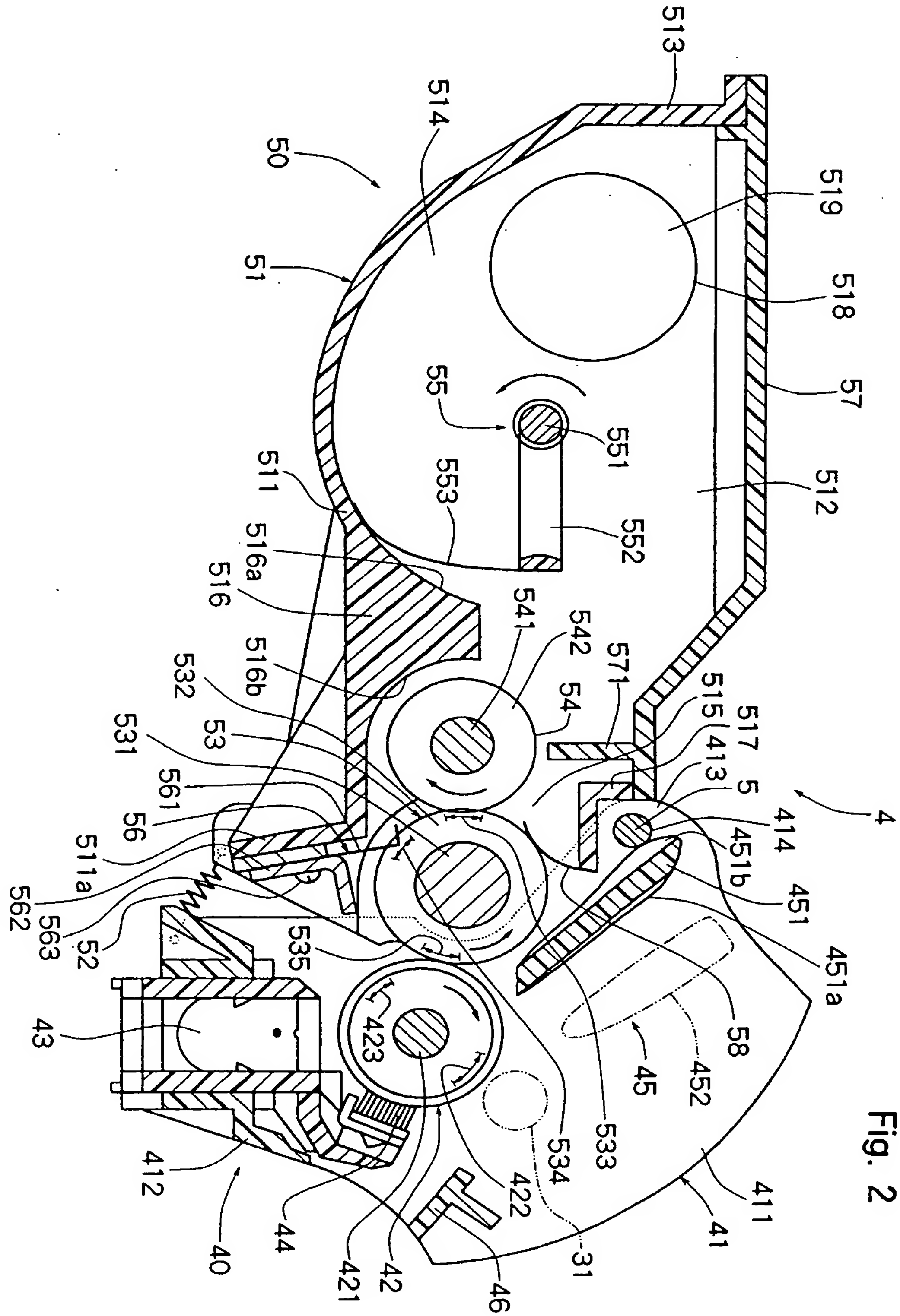
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Fig. 2

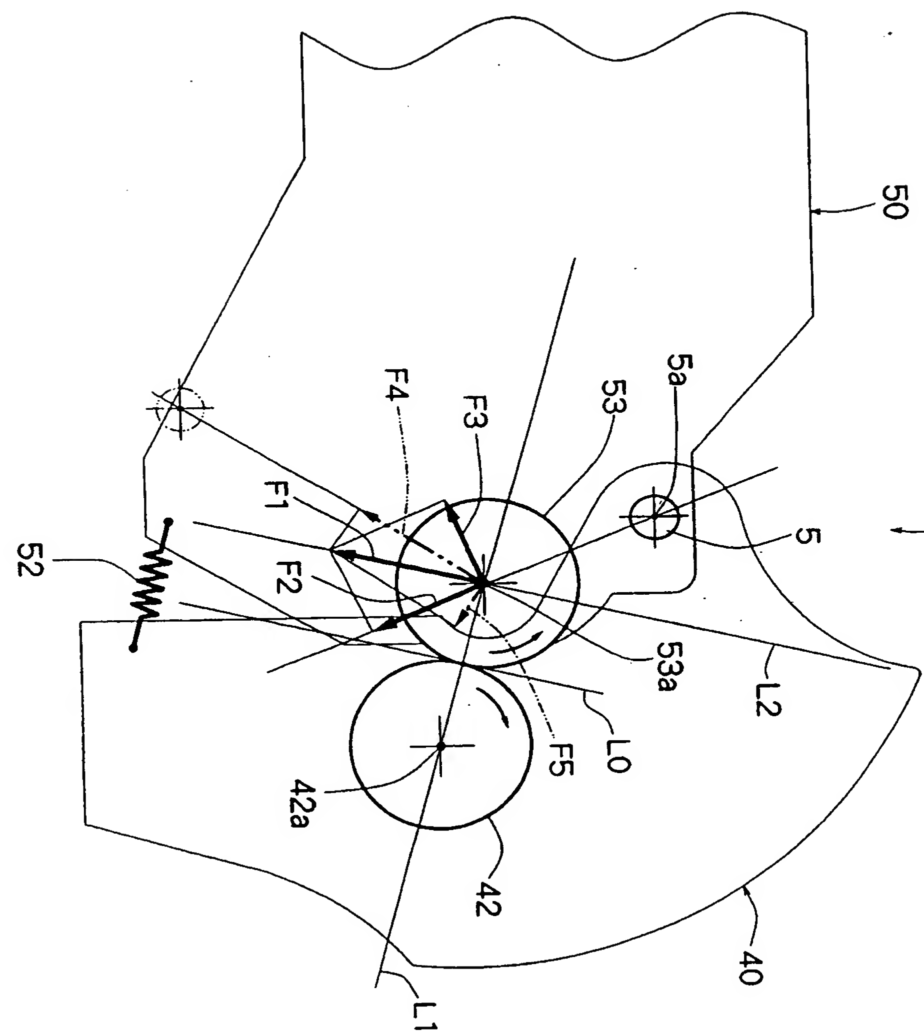

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 8826

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	PATENT ABSTRACTS OF JAPAN vol. 014, no. 565 (P-1143), 17 December 1990 & JP 02 242275 A (RICOH CO LTD), 26 September 1990, * abstract * ---	1 2	G03G21/18 G03G15/08
Y A	US 5 160 964 A (TAKAHASHI HIDEKI ET AL) 3 November 1992 * column 4, line 62 - column 6, line 4 * * column 8, line 35-46 * * figures 6,7A,7B,11 * ---	1 2	
Y A	EP 0 314 140 A (MITA INDUSTRIAL CO. LTD.) 3 May 1989 * column 8, line 29 - column 17, line 25; figures 4,6-9 * ---	1 2	
Y A	PATENT ABSTRACTS OF JAPAN vol. 011, no. 156 (P-578), 21 May 1987 & JP 61 290457 A (RICOH CO LTD), 20 December 1986, * abstract * -----	1 2	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	27 August 1997	Thirlwell, K

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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